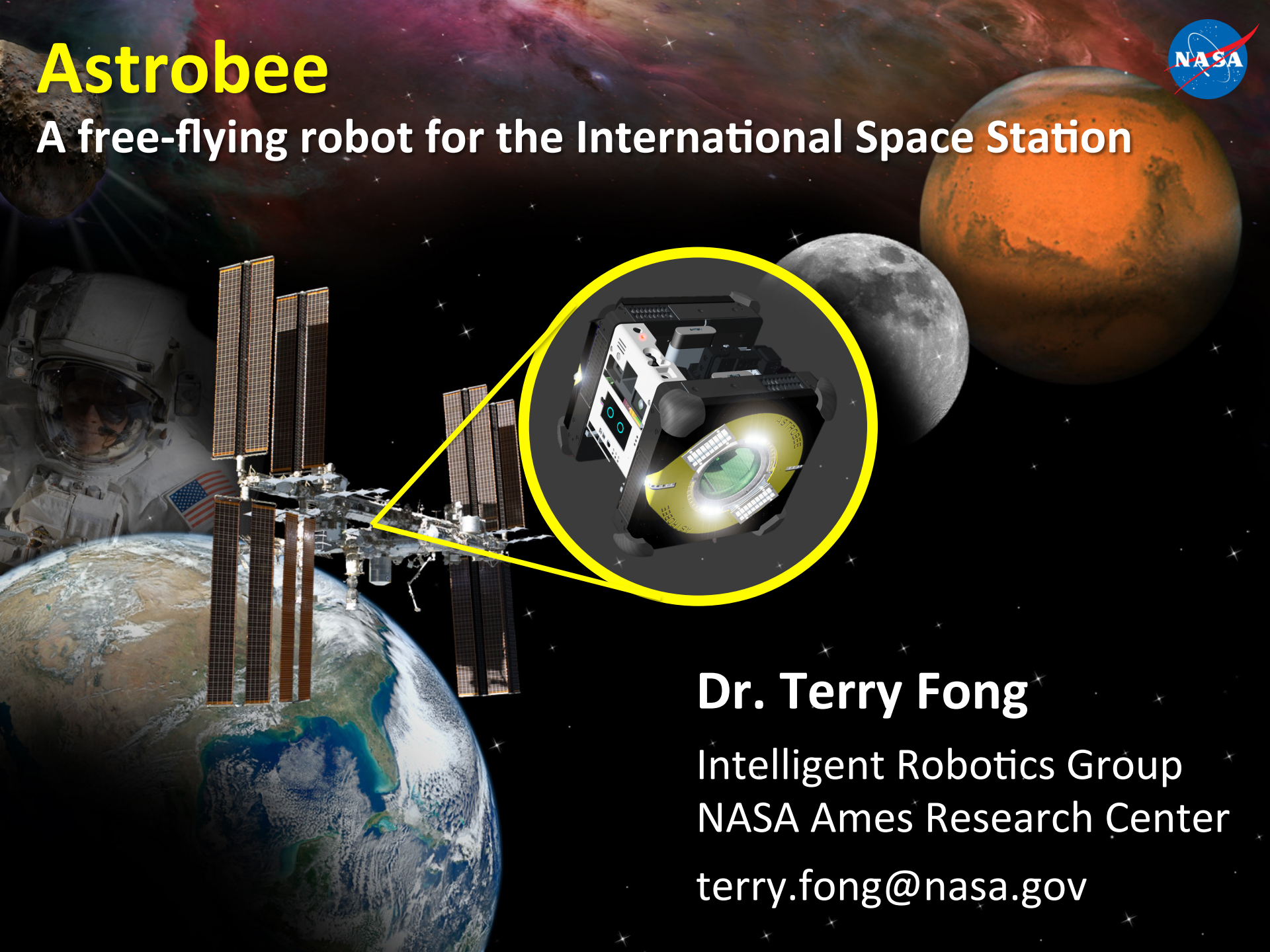


Astrobee

A free-flying robot for the International Space Station



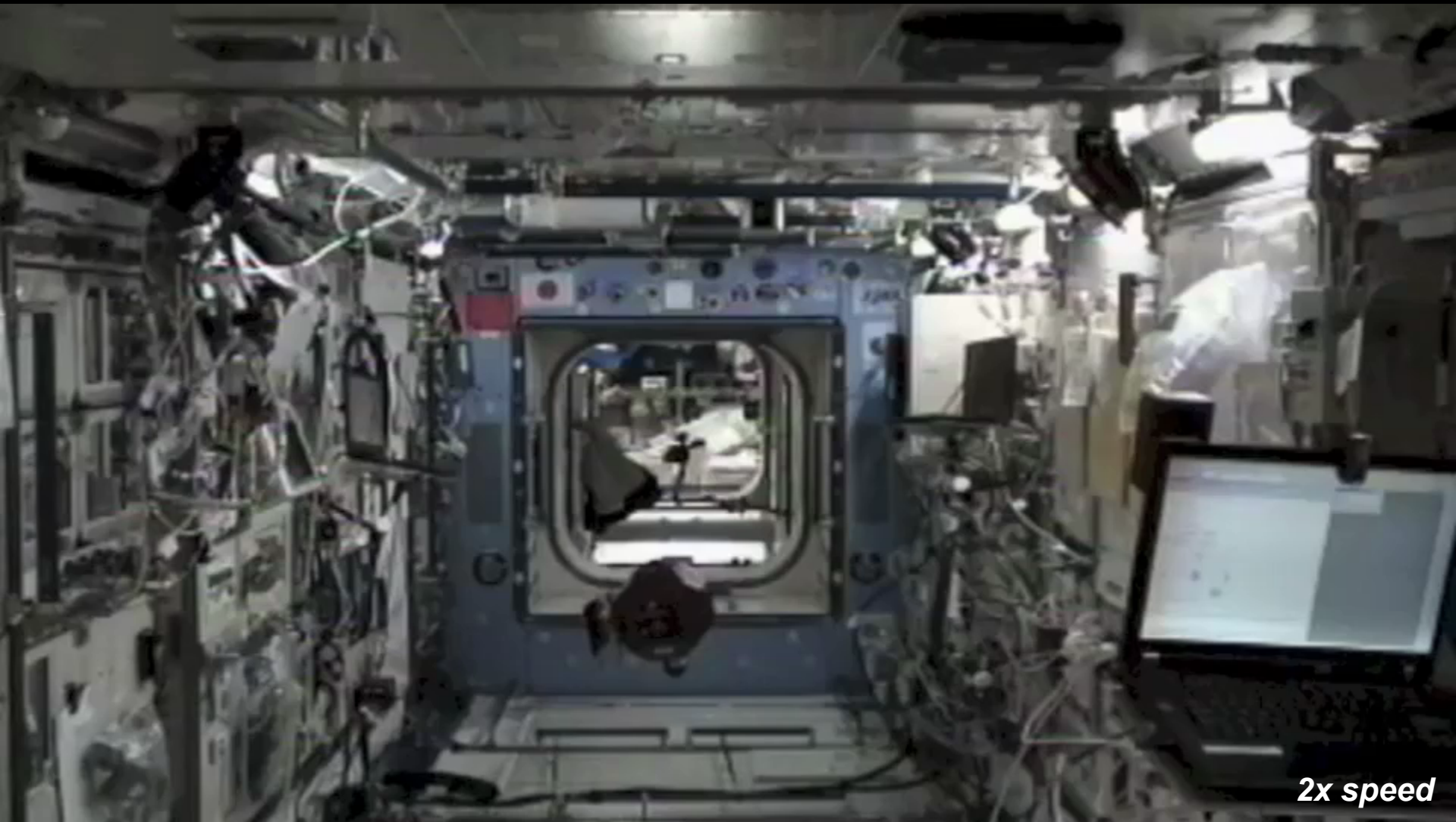
Dr. Terry Fong

Intelligent Robotics Group
NASA Ames Research Center

terry.fong@nasa.gov

A long time ago, in a galaxy
far, far away...

Remote Control of SPHERES



December 2012

Crew: Kevin Ford, Expedition 33 Commander

Astrobee IVA Free-Flying Robot



Key Facts

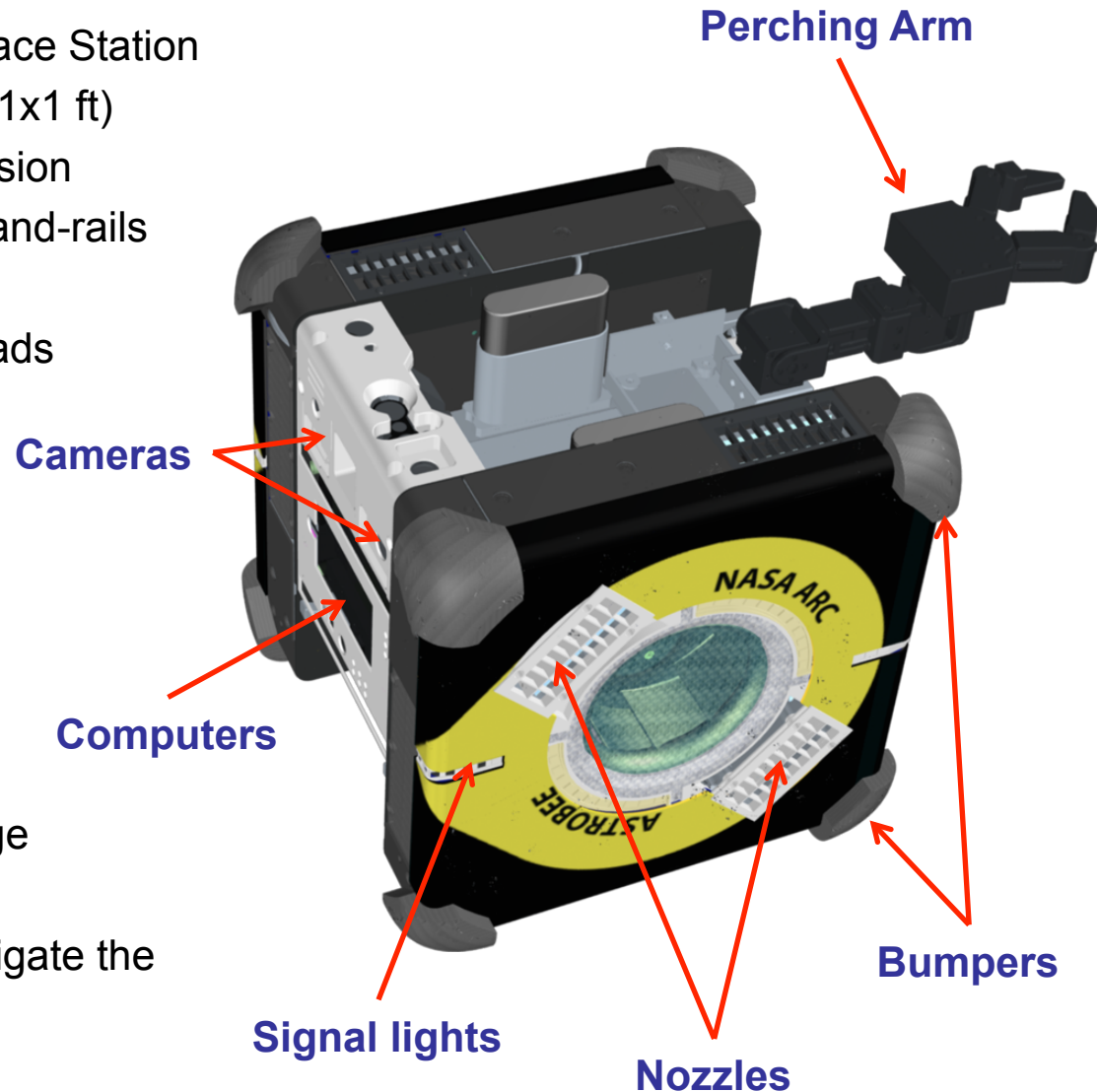
- Free flying robot **inside** the Space Station
- Size: 30x30x30 cm (approx. 1x1x1 ft)
- **All electric** + fan-based propulsion
- Robot arm for “**perching**” on hand-rails
- Three **smartphone** computers
- **Expansion port** for new payloads
- Open-source software

Uses

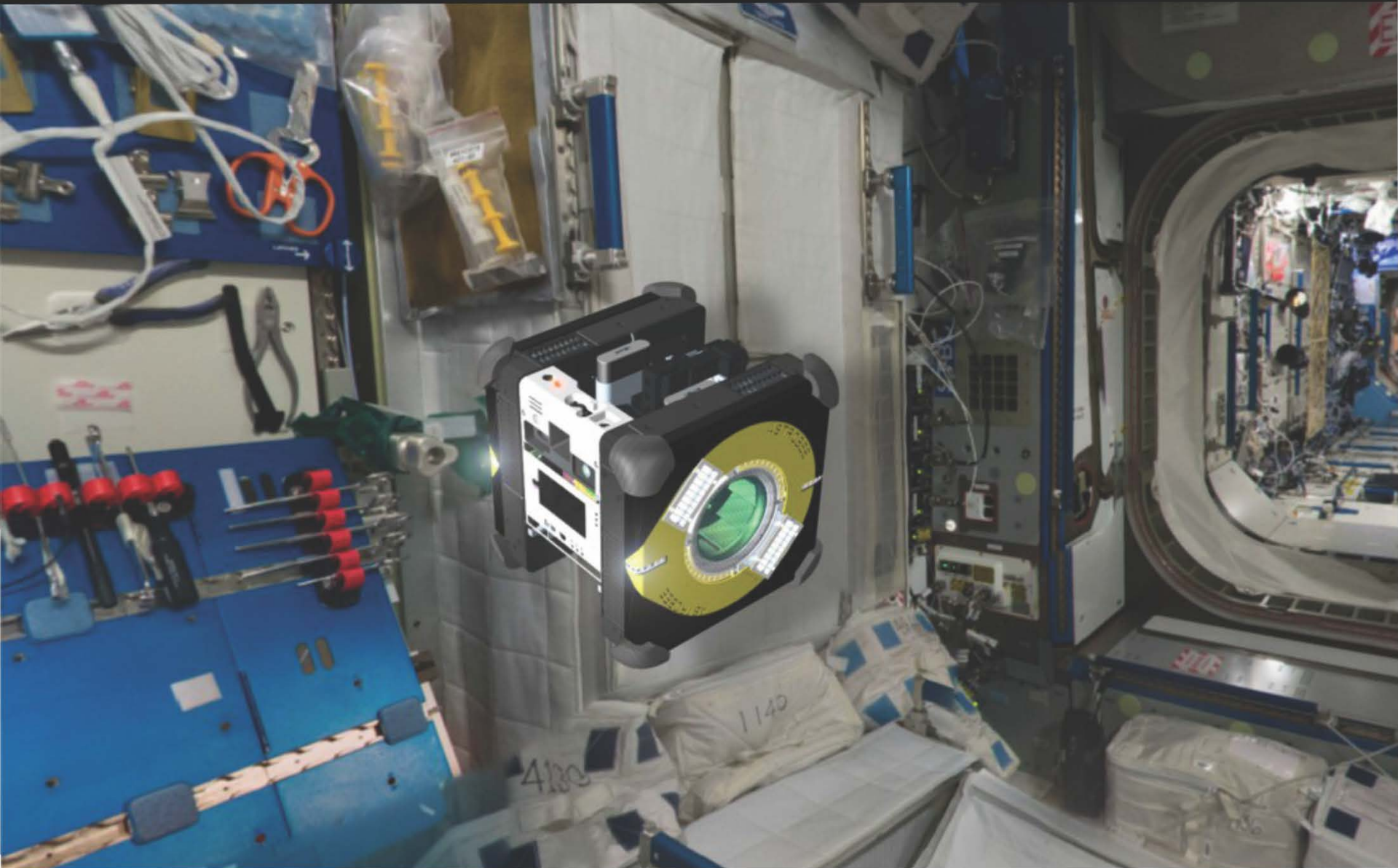
- Mobile sensor
- Remotely operated camera
- Zero-G robotic research

New Technology

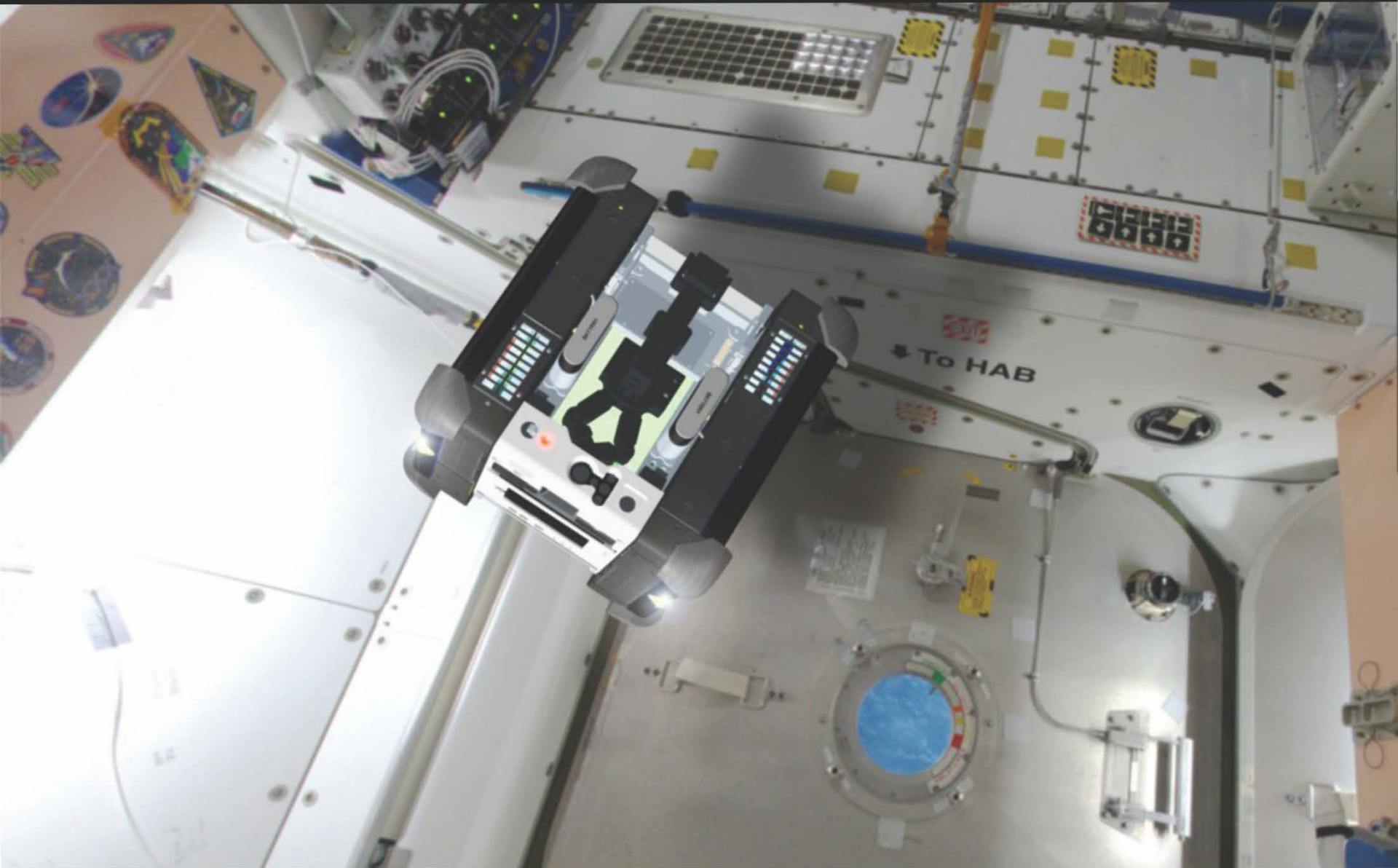
- Autonomous docking & recharge
- Autonomous perching
- Uses on-board cameras to navigate the Space Station



Astrobee on the Space Station (concept)

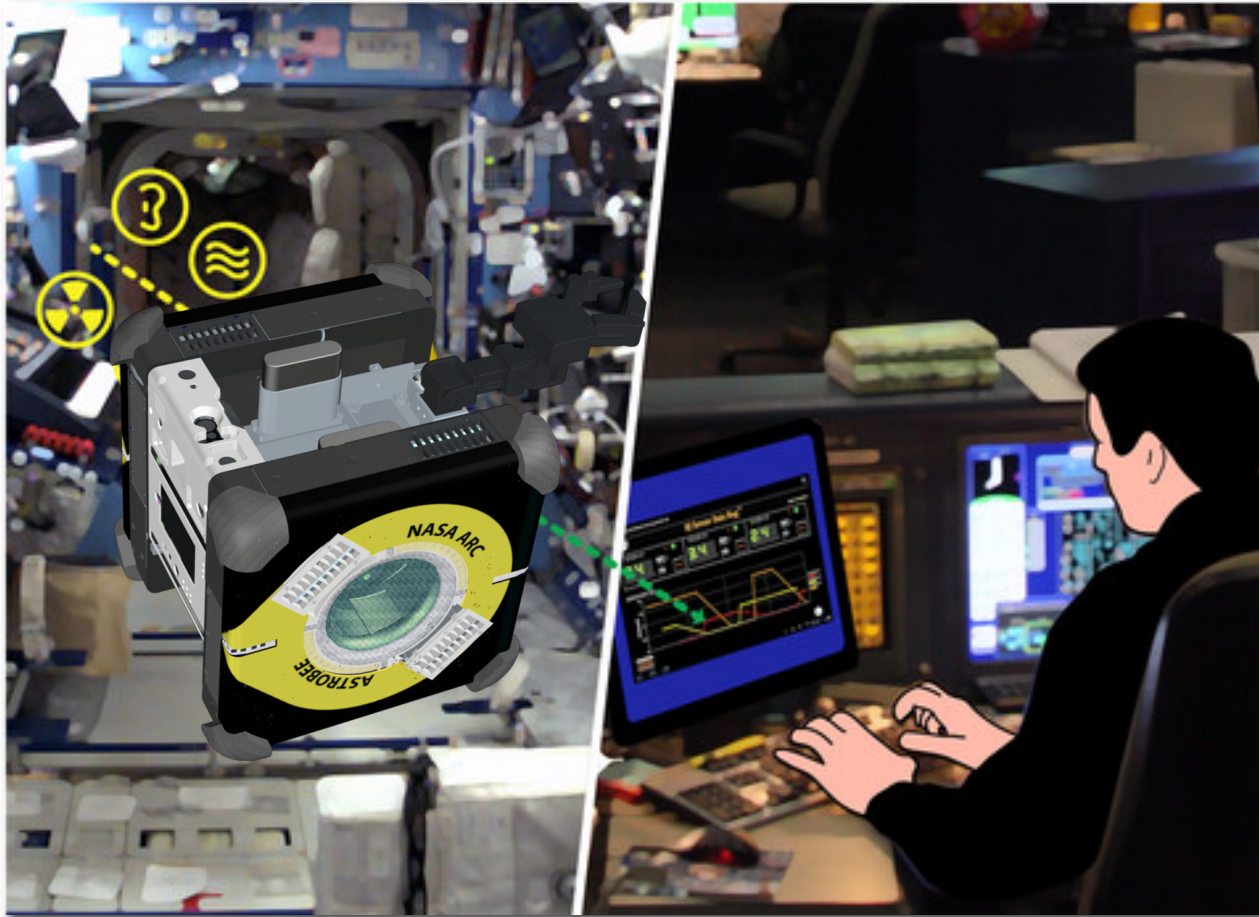


Astrobee on the Space Station (concept)



Astrobee on the Space Station (concept)

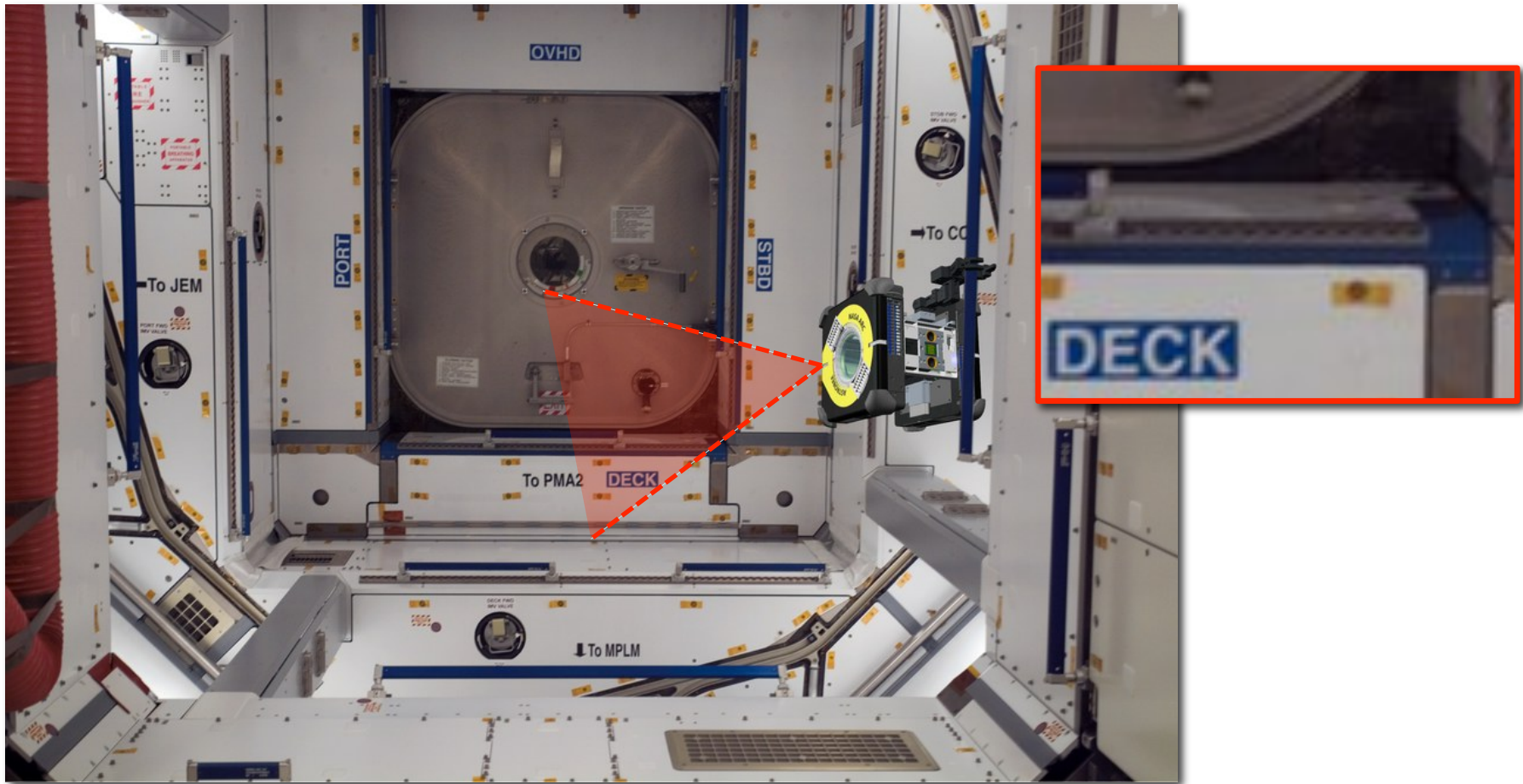




Mission control remotely operates robot to perform ...

- Inventory (RFID tag scanning)
- Environment surveys (air quality, sound levels, etc)

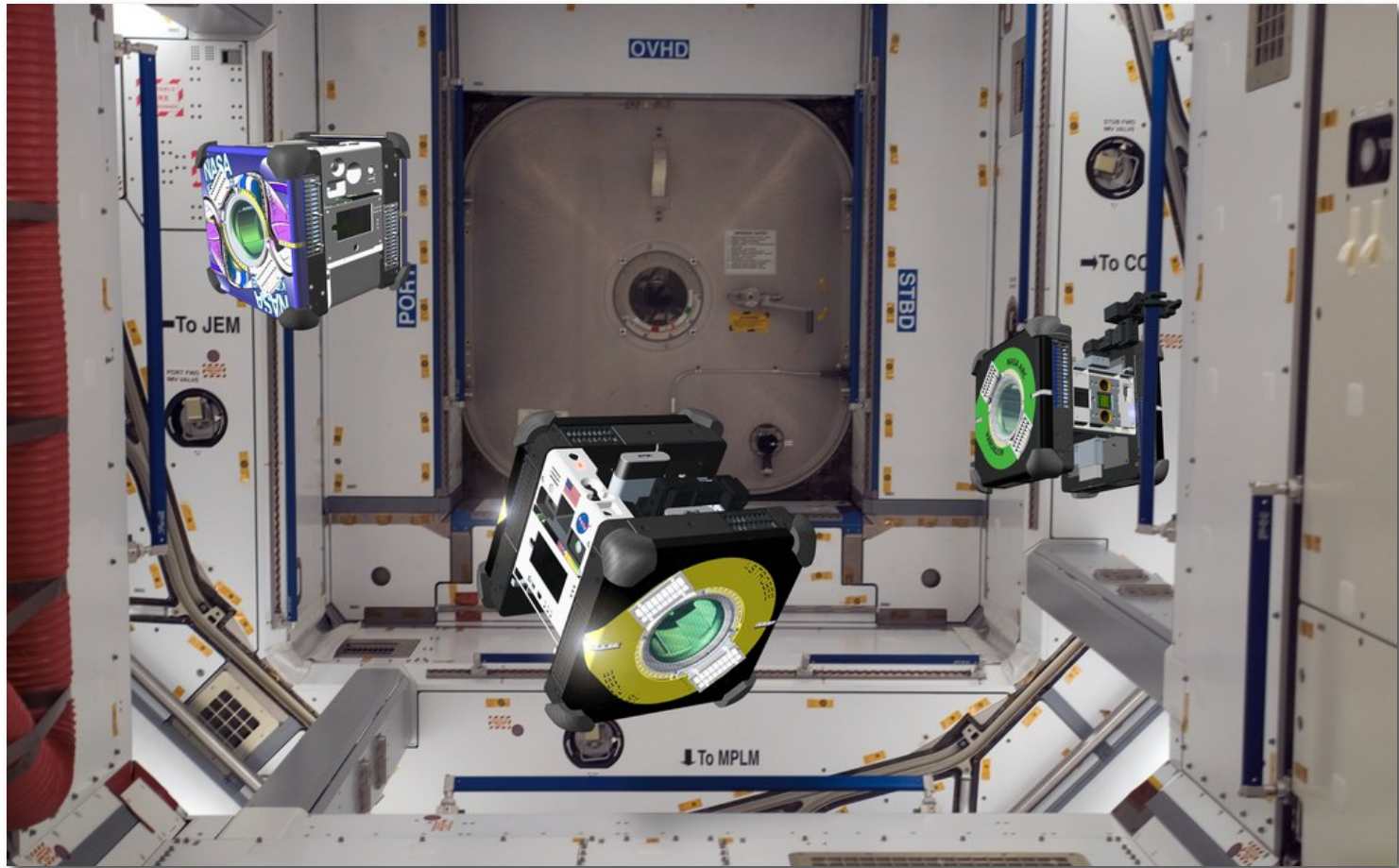
Mobile Camera



Mission control remotely operates robot as a mobile camera to:

- Support astronaut work
- Better understand conditions inside the Space Station

Zero-G Robotic Research



Engineers, researchers, & students can use Astrobee for experiments

- New payloads – sensors, mechanisms, etc.
- New software – control, human-robot interaction, perception, etc.

Lab Testing



June 2016

Dock release and control software testing at NASA Ames

Why “Astrobee”?





National Aeronautics and Space Administration



Ames
Discovery · Innovations · Solutions

ROBOT NAME AND MISSION PATCH CONTEST

- Help **name** a new robot for the Space Station and design a **mission patch** !!!
- NASA Ames is developing a new free-flying robot that will be used inside the International Space Station.
- This robot will do many things, including:
 - Conduct zero-gravity experiments
 - Perform inventory using a Radio Frequency IDentification (RFID) reader
 - Carry cameras and sensors to monitor the space station environment
- For contest details and to enter, visit:
 **robots.topcoder.com**
DEADLINE: October 22, 2014



1. Test diagnostics

2. Before crew activity, ground controller starts free-flyer. Free-flyer prepares for flight.

3. Free-flyer undocks and flies to module.

4. Free-flyer patches and waits for activation.

5. Ground controller adjusts camera position as external module arrives.

6. Free-flyer moves to new perch because external is blocking the view.

7. After activity, free-flyer returns to dock to recharge.

8. In advance of crew activity, ground controller activates the free-flyer: undocks, locates ID and expected location, and initiates SEARCH.

9. Free-flyer undocks and heads to expected location. Free-flyer avoids obstructions and equipment along the way.

10. Free-flyer scans the expected location with its RFID reader, but the tool is not there.

11. Free-flyer initiates automatic search pattern.

12. Free-flyer locates tool at the other side of the module and updates logistics database.

13. Free-flyer returns to dock.



TopCoder challenge

- Announced at NY ComicCon
- 818 registrants (record for this type of challenge)